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DIGITAL PLATE ARCHIVE FOR SUPERNOVA SEARCH AT KONKOLY OBSERVATORY

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Abstract. Digital archives of representative plates obtained with the 0.60/0.90 m Schmidt telescope of the Konkoly Observatory major observing programs are in progress. Here we present the digital archive of plates obtained according to the supernova search program, which has been run since 1962 for more than a 30-year period. The selected plates with a limiting magnitude of $B \approx 19$ mag are scanned with the Konkoly Observatory UMAX PowerLook scanner and are available at the WFPDB, installed in Sofia.

Key words: astronomical databases – surveys – stars: supernovae: general

1. INTRODUCTION

The wide-field photographic observations at Konkoly Observatory were performed with the 0.60/0.90/1.80 m Schmidt telescope (scale: 115″/mm, circular field size: 5°) in the Piszkéstető Mountain Station in 1962–1996. The archive contains about 13 000 observations described in the Konkoly plate catalogue. The catalogue is incorporated in the Wide-Field Plate Database (WFPDB) installed in the Sofia Sky Archive Data Center with a possible on-line search at http://www.skyarchive.org/search/. As an integral part of the WFPDB for some plate images there is online access for quick plate visualization. These plate images, as well as scans suitable for different astronomical tasks are part of the running process of preparation of digital archives of representative plates obtained with the Schmidt telescope of Konkoly Observatory according to some important observing programs. Thus an archive of the digitized plates obtained at Konkoly Observatory for the investigation of the long-term variability of red dwarfs in the Pleiades cluster has been made (Borisova et al. 2003; Tsvetkov et al. 2005a).

One of the important observing programs was the supernova search, started at the end of 1963, when Konkoly Observatory joined the international campaign initiated by F. Zwicky (Detre 1974). With the intention of future scientific investigations and educational use we undertook the creation of the Konkoly Supernovae Search Digital Plate Archive. Konkoly Observatory has a UMAX Power Look 3000 flatbed scanner for the plate scanning. With a resolution of 1600 dpi (16 μm) one Konkoly plate (16×16 cm) can be scanned with total volume of the digitized information about 170 Mb.

2. LIST OF SUPERNOVAE DISCOVERED AT KONKOLY OBSERVATORY

The last supernova patrol observations at Konkoly Observatory were conducted up to the end of 1996. At that point the number of registered supernovae, according to the Harvard List of Supernovae, was 1161. Until the beginning of 2008 October this number is 4782, having in view that only the number of supernovae discovered since the beginning of 2008 up to the moment is 187 (http://www.cfa.harvard.edu/iau/lists/Supernovae.html). We compiled a list of all 50 supernovae discovered at Konkoly Observatory (Table 1) using the data mainly from the Combined Catalogues of Variable Stars (Samus et al. 2004), The Asiago Supernova Catalogue – 10 Years After (Barbon et al. 1999, updated version 2008 March), Sternberg Supernova Catalogue (Tsvetkov et al. 2004) and Harvard List of Supernovae (see the URL above).

Table 1. Supernovae discovered at Konkoly Observatory.

SN	Host galaxy	Date	RA J2000	DEC J2000	Discoverer
1955L	Anon.	1955 03 23	11 04.9	+30 02	Lovas
1964E	UGC 6983	1964 03 12	11 59.2	+52 42	Lovas
1965O	Anon.	1965 01 08	12 02.6	+49 55	Lovas
1966G	NGC 521*	1966 08 16	01 24.6	+01 44	Reaves, Lovas
1967C	NGC 3389	1967 02 28	10 48.4	+12 32	Chuadze, Lovas
1968A**	NGC 1275	1968 01 25	03 19.8	+41 31	Lovas
1968aa	NGC 4975	1968 04 23	13 08.0	−05 01	Mnatsakanian
1968I	NGC 4981	1968 04 23	13 08.7	−06 47	Lovas
1968J	Anon.	1968 05 16	14 05.9	+53 08	Jankovics
1968S	Anon.	1968 09 28	21 44.8	+03 05	Jankovics
1969B	NGC 3556	1969 02 06	11 11.4	+55 40	Wild, Balázs
1969C	NGC 3811	1969 02 09	11 41.3	+47 41	Rosino, Jankovics
1970G	NGC 5457	1970 07 30	14 03.3	+54 21	Lovas
1970M	Anon.	1970 11 26	10 48.3	+14 03	Lovas
1972F	Anon.	1972 05 18	12 07.1	+53 40	Lovas
1972T	Anon	1972 03 15	13 20.3	+31 31	Lovas
1974D	NGC 3916	1974 03 20	11 50.8	+55 08	Lovas
1974E	NGC 4038	1974 03 21	12 01.9	−18 52	Lovas
1975B	Anon.	1975 03 01	03 19.7	+41 38	Lovas
1975G	Anon.	1975 06 11	14 01.3	+54 26	Lovas
1975R	Anon.	1975 12 07	01 39.9	+32 18	Lovas
1976A	NGC 5004	1976 02 28	13 11.1	+29 34	Lovas
1976B	NGC 4402	1976 03 28	12 26.1	+13 06	Lovas
1976C	IC 1231	1976 06 01	16 46.9	+58 27	Paparó
1976G	NGC 488	1976 10 21	01 21.8	+05 16	Lovas, Wild
1976H	IC 1801	1976 10 24	02 28.2	+19 34	Lovas
1976I	Anon.	1976 10 24	01 00.7	−07 05	Lovas
1976M	Anon.	1976 07 26	16 44.9	+58 19	Lovas
1976N	Anon.	1976 10 24	07 32.0	+65 13	Lovas
1977B	NGC 5406	1977 03 18	14 00.3	+38 55	Lovas
1977E	Anon.	1977 12 18	07 58.9	+85 42	Lovas
1978F	Anon.	1978 11 02	07 52.9	+73 19	Lovas

Table 1. Continued

SN	Host galaxy	Date	RA J2000	DEC J2000	Discoverer
1980A	UGC 7395	1980 02 21	12 20.4	+31 10	Lovas
1980B	Anon.	1980 02 22	11 19.8	+54 28	Lovas
1980C	Anon.	1980 02 22	13 45.4	+47 45	Lovas
1980E	Anon.	1980 04 18	13 19.7	+34 14	Lovas
1981G	NGC 4874	1981 06 02	12 59.6	+27 58	Lovas
1982C	NGC 4185	1982 03 22	12 13.3	+28 30	Lovas
1982O	NGC 521*	1982 08 19	01 24.6	+01 44	Lovas
1982W	NGC 5485	1982 12 14	14 07.1	+55 00	Lovas
1982X	UGC 4778	1982 02 19	09 07.1	+50 43	Lovas
1982Y	UGC 5449	1982 02 20	10 07.9	+68 21	Lovas
1984M	IC 121	1984 08 29	01 28.4	+02 31	Lovas
1985J***	Anon.	1985 05 10	11 15.0	+33 49	Lovas
1985O	UGC 511	1985 09 09	00 50.1	+31 44	Lovas
1986A	NGC 3367	1986 02 04	10 46.7	+13 45	Evans et al., Lovas
1987M	NGC 2715	1987 09 21	09 08.1	+78 05	Lovas
1988R	MCG09-23-9	1988 08 18	13 48.2	+54 48	Lovas
1989X	Anon.	1989 11 30	07 28.3	+63 54	Lovas
1995am	Anon.	1995 10 22	00 47.8	+29 58	Lovas

Notes to Table 1.:

* Two SNe in NGC 521 were discovered at Konkoly Observatory (1966G and 1982O). Considering 2006G, the galaxy could be added to the list of galaxies with three or more supernovae: NGC 521 (3 SN), NGC 2841 (4 SN), NGC 3184 (4 SN), NGC 3938 (3 SN), NGC 4157 (3 SN), NGC 4303 (5 SN), NGC 4321 (5 SN), NGC 5236 (6 SN), NGC 6946 (9 SN).

** Positional coincidence with the jet-like radio structure published in Meusinger & Brunzendorf (1996).

*** The star 1985J is included in The Asiago Supernova Catalogue – 10 years after (Barbon et al. 1999) as an object which turned out not to be a supernova.

3. WFPDB KON060 CATALOGUE

The plate archive of the Konkoly 0.60/0.90/1.80 m Schmidt telescope contains 12 707 plates (11 736 direct and 971 spectral, made with 2° or 5° objective prisms), obtained in 1962–1996 with a size of 16×16 cm and a limiting magnitude of ~ 19 mag (B). The photographic filters used are standard Johnson *UBV(RI)*: UG1,2, GG13, GG14, RG1, RG5, in combination with KODAK emulsions: 103aO, IIaO, OaO (for U, B, *pg*); IIIaJ, 103aD, IIaD, OaD (for V); 103aF, 103aE, 098, IIIaF (for R); IN, IVN (for I). A half of the plates were taken with an exposure of 15 min. The astronomer in charge for the archive is L. G. Balázs.

Table 2. Plates that could be best associated by temporal and positional coincidence to supernovae discovered at Konkoly Observatory.

SN	Date	RA J2000	DEC J2000	Pl. No.	Date	RA J2000	DEC J2000
1955L	1955 03 23	11 04.9	+30 02		Discovered on POSS		
1964E	1964 03 12	11 59.2	+52 42	000339	1964 03 12	12 05 32	+51 51 18
1965O	1965 01 08	12 02.6	+49 55	000591	1965 01 08	12 05 32	+51 08 18
1966G	1966 08 16	01 24.6	+01 44	001024	1966 08 13	01 18 35	+02 42 46
				001025	1966 08 13	01 18 35	+02 42 46
1967C	1967 02 28	10 48.4	+12 32	001267	1967 03 10	10 46 39	+14 07 10
1968A	1968 01 25	03 19.8	+41 31	002050	1968 01 25	03 17 20	+42 34 59
				002051	1968 01 25	03 15 20	+42 35 05
1968I	1968 04 23	13 08.7	–06 47	002315	1968 04 24	13 09 36	–05 33 58
				002317	1968 04 24	13 09 36	–05 33 58
1968J	1968 05 16	14 05.9	+53 08	002336	1968 05 16	14 02 46	+54 37 36
				002337	1968 05 16	14 02 46	+54 37 36
1968S	1968 09 28	21 44.8	+03 05	002578	1968 09 28	21 47 32	+02 49 56
				002579	1968 09 28	21 47 32	+02 49 56
1968aa	1968 04 23	13 08.0	–05 01	002315	1968 04 24	13 09 36	–05 33 58
				002317	1968 04 24	13 09 36	–05 33 58
1969B	1969 02 06	11 11.4	+55 40	002930	1969 02 11	10 59 01	+56 15 55
				002931	1969 02 11	10 59 01	+56 15 55
1969C	1969 02 09	11 41.3	+47 41	002948	1969 02 11	11 51 37	+47 00 19
				002949	1969 02 12	11 51 37	+47 00 19
1970G	1970 07 30	14 03.3	+54 21	003663	1970 07 30	14 00 48	+53 45 32
				003664	1970 07 30	14 00 48	+53 45 32
				003675	1970 07 31	14 00 48	+53 45 32
				003685	1970 08 01	14 00 48	+53 45 32
1970M	1970 11 26	10 48.3	+14 03	003847	1970 11 26	10 46 38	+12 24 10
				003848	1970 11 26	10 46 38	+12 24 10
1972F	1972 05 18	12 07.1	+53 40	004584	1972 05 18	12 05 32	+51 51 18
				004585	1972 05 18	12 05 32	+51 51 18
1972T	1972 03 15	13 20.3	+31 31	004501	1972 03 15	13 14 20	+32 27 08
1974D	1974 03 20	11 50.8	+55 08	005713	1974 03 20	11 56 36	+56 33 18
				005714	1974 03 20	11 56 36	+56 33 18
1974E	1974 03 21	12 01.9	–18 52	005722	1974 03 21	11 58 33	–19 04 42
				005723	1974 03 21	11 58 33	–19 04 42
1975B	1975 03 01	03 19.7	+41 38	006038	1975 03 01	03 16 20	+42 34 02
				006039	1975 03 01	03 16 20	+42 34 02
1975G	1975 06 11	14 01.3	+54 26	006164	1975 06 11	14 00 48	+53 45 32
				006165	1975 06 11	14 00 48	+53 45 32
1975R	1975 12 07	01 39.9	+32 18	006409	1975 12 07	01 35 50	+30 53 18
				006410	1975 12 07	01 35 50	+30 53 18
1976A	1976 02 28	13 11.1	+29 34	006592	1976 02 28	13 06 23	+28 53 58
				006593	1976 02 28	13 06 23	+28 53 58
1976B	1976 03 28	12 26.1	+13 06	006648	1976 03 28	12 28 32	+14 08 25
				006649	1976 03 28	12 28 32	+14 08 25
1976C	1976 06 01	16 46.9	+58 27	006803	1976 06 01	16 33 47	+59 41 50
				006804	1976 06 01	16 33 47	+59 41 50

Table 2. Continued

SN	Date	RA J2000	DEC J2000	Pl. No.	Date	RA J2000	DEC J2000
1976G	1976 10 21	01 21.8	+05 16	007022	1976 10 21	01 23 35	+03 35 38
				007023	1976 10 21	01 23 35	+03 35 38
1976H	1976 10 24	02 28.2	+19 34	007038	1976 10 24	02 31 49	+21 06 14
				007039	1976 10 24	02 31 49	+21 06 14
1976I	1976 10 24	01 00.7	–07 05	007054	1976 10 24	00 57 32	–06 33 48
				007055	1976 10 24	00 57 32	–06 33 48
1976M	1976 07 26	16 44.9	+58 19	006909	1976 07 26	16 33 47	+59 41 50
				006910	1976 07 26	16 33 47	+59 41 50
1976N	1976 10 24	07 32.0	+65 13	007046	1976 10 24	07 23 50	+65 14 11
				007047	1976 10 24	07 23 50	+65 14 11
1977B	1977 03 18	14 00.3	+38 55	007266	1977 03 18	13 52 08	+39 35 13
				007267	1977 03 18	13 52 08	+39 35 13
1977E	1977 12 18	07 58.9	+85 42	007680	1977 12 18	07 25 05	+85 09 27
				007681	1977 12 18	07 25 05	+85 09 27
1978F	1978 11 02	07 52.9	+73 19	008176	1978 11 02	08 22 41	+73 35 26
				008177	1978 11 02	08 22 41	+73 35 26
1980A	1980 02 21	12 20.4	+31 10	008876	1980 02 21	12 13 32	+30 13 19
				008877	1980 02 21	12 13 32	+30 13 19
1980B	1980 02 22	11 19.8	+54 28	008880	1980 02 21	11 10 54	+54 03 42
				008881	1980 02 22	11 10 54	+54 03 42
1980C	1980 02 22	13 45.4	+47 45	008882	1980 02 22	13 32 06	+47 04 36
				008883	1980 02 22	13 32 06	+47 04 36
1980E	1980 04 18	13 19.7	+34 14	008976	1980 04 18	13 14 18	+36 44 08
				008977	1980 04 18	13 14 18	+36 44 08
				008978	1980 04 18	13 14 20	+32 27 08
				008979	1980 04 18	13 14 20	+32 27 08
1981G	1981 06 02	12 59.6	+27 58	009303	1981 06 02	13 06 23	+28 53 58
				009304	1981 06 03	13 06 23	+28 53 58
1982C	1982 03 22	12 13.3	+28 30	009533	1982 03 22	12 13 32	+30 13 19
				009534	1982 03 22	12 13 32	+30 13 19
1982O	1982 08 19	01 24.6	+01 44	009678	1982 08 19	01 23 34	+00 52 38
				009679	1982 08 19	01 23 34	+00 52 38
1982W	1982 12 14	14 07.1	+55 00	009907	1982 12 14	14 00 48	+53 45 32
				009908	1982 12 14	14 00 48	+53 45 32
1982X	1982 02 19	09 07.1	+50 43	009472	1982 02 20	09 08 32	+51 32 51
				009473	1982 02 20	09 08 32	+51 32 51
1982Y	1982 02 20	10 07.9	+68 21	009474	1982 02 20	09 56 07	+69 20 45
				009475	1982 02 20	09 56 07	+69 20 45
1984M	1984 08 29	01 28.4	+02 31	010474	1984 08 29	01 23 35	+03 35 38
				010475	1984 08 29	01 23 35	+03 35 38
				010476	1984 08 29	01 23 34	+00 52 38
				010477	1984 08 29	01 23 34	+00 52 38
1985J	1985 05 10	11 15.0	+33 49	010626	1985 05 10	11 11 44	+34 15 41
				010627	1985 05 10	11 11 44	+34 15 41
1985O	1985 09 09	00 50.1	+31 44	010770	1985 09 10	00 54 43	+30 31 15
				010771	1985 09 10	00 54 43	+30 31 15

Table 2. Continued

SN	Date	RA J2000	DEC J2000	Pl. No.	Date	RA J2000	DEC J2000
1986A	1986 02 04	10 46.7	+13 45	011001	1986 02 07	10 46 38	+12 24 10
				011002	1986 02 07	10 46 38	+12 24 10
1987M	1987 09 21	09 08.1	+78 05	011526	1987 09 21	08 53 29	+78 06 42
				011527	1987 09 21	08 53 29	+78 06 42
1988R	1988 08 18	1348.2	+54 48	011798	1988 08 18	14 00 48	+53 45 32
				011799	1988 08 18	14 00 48	+53 45 32
1989X	1989 11 30	07 28.3	+63 54	012137	1989 11 30	07 23 50	+65 14 11
				012138	1989 11 30	07 23 50	+65 14 11
1995am	1995 10 22	00 47.8	+29 58	013000	1995 10 22	00 54 43	+30 31 15
				013001	1995 10 22	00 54 43	+30 31 15

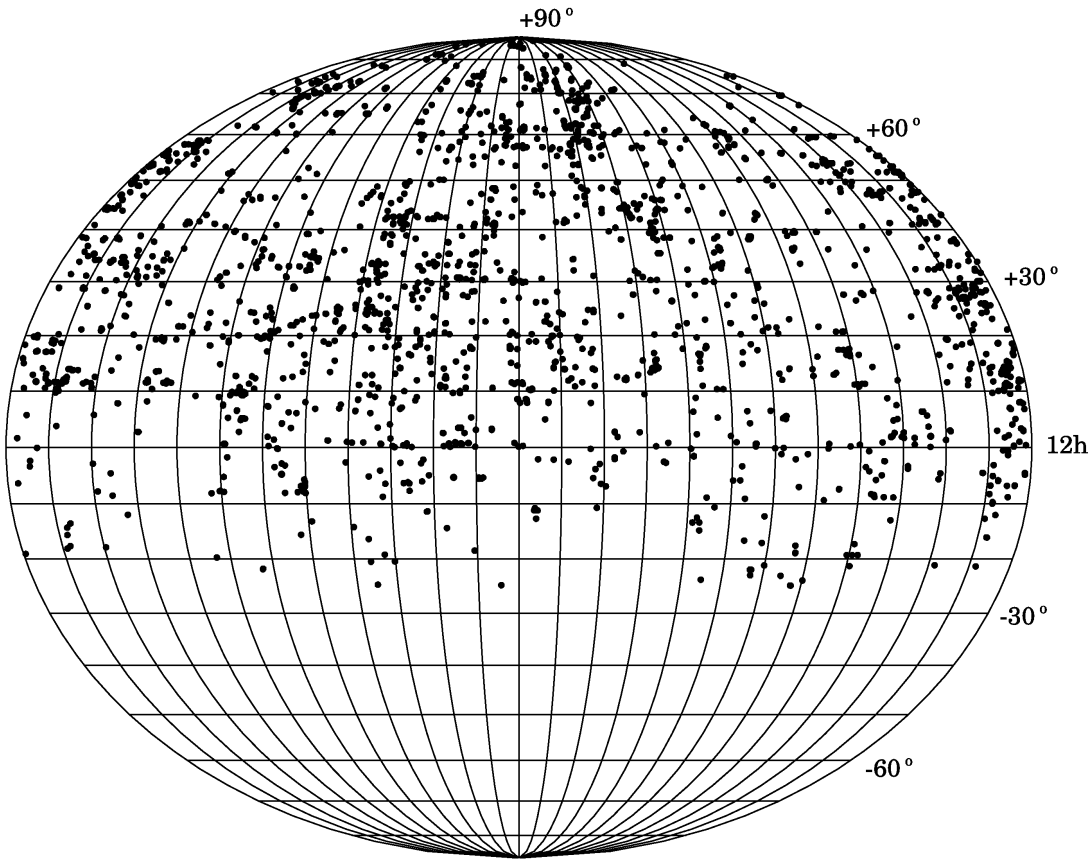

Fig. 1. All-sky distribution of the KON060 plate centers.

The original plate catalogs of the Konkoly Schmidt telescope archive were reduced to the required format and incorporated to the WFPDB, where one can find it with the KON060 WFPDB identifier. The mistakes, made mainly during the conversion of the plate archive information into a computer-readable catalog, were corrected. Some results of the KON060 catalog analysis based on the data

retrieval from the WFPDB have been presented in Tsvetkov et al. (2005b). During the present work we revealed some more mistakes of another origin. The types of the mistakes found can be summarized as follows: misprints, incorrectly assigned code for the observed object during the reduction to the WFPDB format, wrong translation of the names of the objects from Hungarian to English.

The origin of the undertaken task put requirements not only for corrections of the newly found mistakes but also for additional plate information, which modified the results of the catalog analysis of Tsvetkov et al. (2005b).

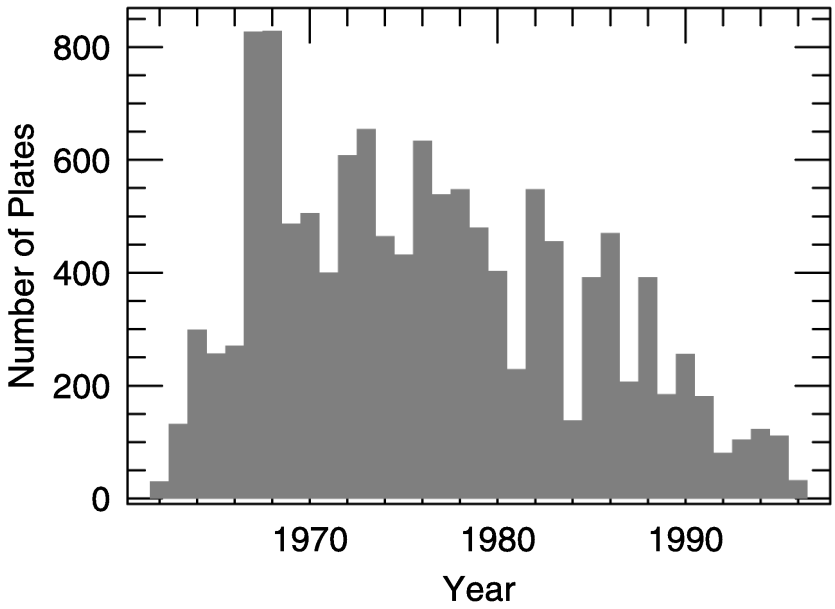

Fig. 2. Time distribution of amount of the Konkoly Schmidt telescope plates.

Some statistical results of supernova observations from the analysis of the KON060 corrected and enlarged with plate information catalog are presented in Figures 1–3. All-sky distribution of the KON060 plate centers taken from the WFPDB – Sofia Search Page (http://draco.skyarchive.org/search/search.cgi) is given in Figure 1. The time distribution of the obtained plates (Figure 2) compared with the time distribution of the supernovae discovered at Konkoly Observatory (Figure 3) revealed a coincidence between the maxima of the observational activity and the time of the supernova discoveries: six SN were discovered at the maximum of 1967–1968, two in 1973–1973, six in 1976 and five in 1982.

4. KONKOLY SUPERNOVA DIGITAL PLATE ARCHIVE

Having at disposal the compiled list of Konkoly supernovae and using the search procedure provided by the WFPDB in Sofia Sky Archive Data Center, the plates with registered supernovae events were determined (Table 2) taking into account that in the supernova search program two successive plates were obtained for every control field with an exposure duration of 15 min.

The selected plates with the best temporal and positional coincidence with the discovered supernovae were scanned with the UMAX PowerLook 3000 FB scanner

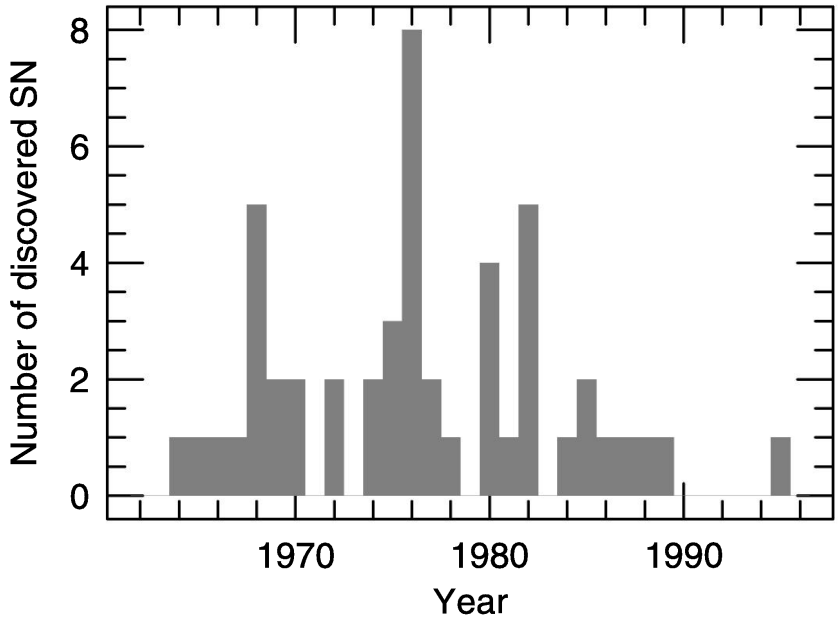

Fig. 3. Time distribution of the supernovae discovered at Konkoly Observatory.

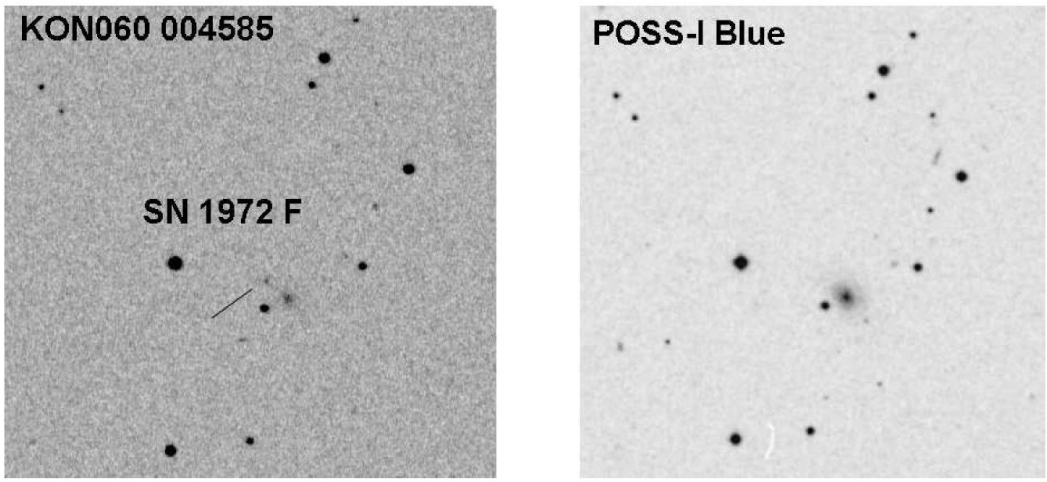

Fig. 4. Part of KON060 004585 plate with the discovered SN 1972F and the same region from POSS-I Blue.

with a resolution of 300 dpi (85 μm) for quick plate visualization (data volume of 6 MB), then with 1600 dpi (16 μm) for photometric tasks (average volume of 170 MB) and with the maximal resolution of 3048 dpi (8 μm) in the region around supernova (30 MB).

Up to the moment 106 KON060 plates have been scanned. For bad quality plates only previews have been made. Unfortunately the discovery plates of some supernovae were not found – for 1968A (plates Nos. 2050, 2051), 1970G (3663, 3664), 1975B (6038, 6039) and 1975R (6409, 6410). The volume of data stored in TIFF format files is 19 GB. The plate visualization scans (so called preview scans) can be accessed on-line in the WFPDB. The scans, intended to be used

for astronomical tasks (so-called real scans) are presently stored in the Sofia Sky Archive Data Center and can be obtained upon request (we intend to deposit the material in the Electronic Archive of Konkoly Observatory as well). In Figure 4 a part of KON060 004585 – the discovery plate of SN 1972F – and the same region from POSS-I blue chart are shown.

The final database (in preparation) contains the following information: supernova data and discovery information, publication bibliographic data (bibcode), plate metadata, plate quick visualization scan, plate large resolution scans (full plate and partial plate around the supernova location), image metadata characteristics, other plates in the same field, POSS image link.

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